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ORIGINAL COMMUNICATION

Low depressive symptoms in acute spinal cord injury compared to other neurological disorders

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Abstract The aim of the study was to reveal the incidence and time course of depressive symptoms following acute spinal cord injury (SCI) in relation to clinical outcomes for comparison to other neurological disorders with severe impairment. In patients with acute traumatic SCI ($n = 130$), combined follow up assessments of neurological and functional outcomes, pain and patient-rated affective factors (e.g. mood, anxiety) were prospectively (1, 3, 6, 12 months after injury) collected during rehabilitation and follow up in out-patient clinics. We related these to the severity of depressive symptoms (no, mild, moderate and severe) based on the Beck Depression Inventory (BDI) scores. The mean 65% of patients showed no depressive symptoms and 30% mild depressive symptoms, while less than 5% presented moderate to severe depressive symptoms. The group findings and symptoms in individual patients remained stable over 1 year though patients revealed significant clinical recovery. Although two-thirds of the patients experienced pain, BDI scores were not related to pain intensity. BDI mean scores were only slightly higher than in control populations, but rather low compared to patients with other neurological disorders (e.g. stroke and multiple sclerosis) that are also associated with severe functional impairment. The prevalence of depressive symptoms following acute SCI is rather low and remains stable within the first year after injury despite the severe neurological impairment and loss of independency. In comparison to other neurological disorders that also involve brain function SCI patients seem to be less challenged by depressive symptoms that constitute additional burdens to respond to the severe functional impairments.

Keywords Depressive symptoms · Spinal cord injury · Beck Depression Inventory · ASIA · Neurological disorders

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Introduction

Historically, depressive disorders have been considered an inevitable consequence in patients with acute spinal cord injury [17]. Depressive symptoms were considered to demonstrate the acceptance of the permanent loss of function, while their absence was regarded as a denial ultimately disabling appropriate grieving [13, 33]. Eventually the potential role and assumed necessity of depression became questioned not only due to the consideration of the manifold negative consequences [1]. Currently, it seems to be established that experiencing a depressive episode following a serious medical disorder is based on multiple factors (e.g. genetic predisposition, individual coping strategies, personal resources and environmental factors) [1, 11].

In literature a wide range in the prevalence of major depression or depression-like conditions (7–31%) is reported following SCI [8, 10] due to two main factors. First, the definition of depression and corresponding disorders varies considerably. It ranges from the description of rather unspecific symptoms (in terms like despondency and grief) to even, although rarely, formally diagnosed major depressive disorders according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) or a severe depressive episode according to the International

Classification of Diseases (ICD-10) [11]. Secondly, mostly different cross-sectional cohorts of patients within the wide continuum after SCI were assessed with an inherent danger of a selection bias [19]. In addition, most studies report point prevalence at a rather wide time window after injury while far less is known about the longitudinal course of depression in people with acute SCI. Therefore, a prospective, multicenter international study design was chosen in a standardized European network of specialized SCI centers to collect data from the acute to chronic stage of SCI and relate the findings of depressive symptoms with other clinical factors. Besides total group mean values, the course of depressive symptoms in individual SCI subjects were also analyzed. It was hypothesized that SCI patients, although suffering from severe neurological and functional impairment, might be differently positioned to counter the challenges in independence compared to other neurological disorders with comparably severe impairment but additional involvement of brain function.

Methods

All patients participated in the European Multicenter Study for Human Spinal Cord Injury (EM-SCI). Data were assessed at 1 month (16–40 days), 3 months (70–98 days), 6 months (150–186 days) and 12 months (300–400 days) after traumatic SCI. The sample consisted of 130 subjects (25 women; mean age 48 years, range 18–85 years). Data sets of 123 participants at 1 month, 130 at 3 months, 125 at 6 months and 80 at 12 months post-injury were included in the analysis; all subjects had a minimum of three assessments.

The lesions were in the cervical ($n = 56$), thoracic (high T1–T6, $n = 22$; low T7–12, $n = 34$) or lumbar (16) regions. The American Spinal Injury Association (ASIA) classification included AIS A (45), B (9), C (17) and D (57) and E (1) patients. Data on 75 patients were available for the duration of rehabilitation. The mean stay in a rehabilitation setting was 120 days (±55, range from 14–259 days).

Patients with reduced capabilities for cooperation (e.g. dementia, language barriers) and patients who sustained a head or brain lesion (like severe contusion or intra-cerebral hemorrhage) associated with the traumatic SCI, were excluded. All participants gave informed consent and the study was approved by the local ethics committees of the participating centers.

Assessment of depression

The Beck Depression Inventory (BDI-I), a 21-question self-report inventory based on the DSM-IV system was applied to assess the occurrence and intensity of depressive symptoms. Each item is rated from 0 to 3 due to its intensity with a maximum score of 63. While the BDI on its own is not considered to diagnose a depressive disorder, it is conceived as a screening tool of depressive symptoms [6]. The BDI could be insensitive to distinguish between somatic symptoms of depression and physical consequences of the SCI, e.g. symptoms like fatigue and insomnia [7]. To overcome these potential shortcomings Kendall's cut-off scores were used (no 0–9; mild 10–18; moderate 19–29; and severe 30–63 depressive symptoms) [29].

Assessment of neurological impairment

The neurological assessment was performed in accordance with International Standards in the Neurological Classification of Spinal Cord Injury (ISNCSCI) [3]. It categorizes SCI patients into five American Spinal Injury Association Impairment Scales (AIS A–E): AIS A, sensory-motor complete, no motor or sensitive function in sacral segments S4–S5; AIS B, motor complete, but sensory incomplete, sensitive function exists below the level of lesion, including S4–S5; AIS C, sensory-motor incomplete, with average strength of muscles below the level of lesion <3 (i.e. movement over the full range of motion against gravity); AIS D, sensory-motor incomplete, with average muscle strength ≥ 3 and AIS E normal motor and sensitive functioning.

Assessment of pain and patient-rated affective factors

Pain intensity was rated on an 11-point Numerical Rating Scale (NRS) and computed as a mean of intensity at the time of the examination, average and maximum pain intensity during the last week. In addition, affective coherent factors associated with depression were included [10]. These parameters, subjectively rated by the patients on a NRS (from 0 very poor–10 very good) during the last 7 days, were mood, anxiety and, limitation in daily life. General health was rated on a five-point rating scale from very bad to very good [37].

Assessment of independence in activities of daily life

Functional independence was quantified by the Spinal Cord Independence Measure (SCIM III), which is currently the recommended tool in persons with SCI [3, 37]. The SCIM contains three clinically weighted subcategories: self-care, respiration and sphincter management, and mobility. The maximum score of 100 indicates best performance.

Antidepressant medication

Any antidepressant medication was recorded, which included all approved antidepressants such as tri- and tetracyclic antidepressants, selective serotonin and/or noradrenalin

reuptake inhibitors (SSRI, NARI, SNRI). There was no distinction due to the indication of antidepressant medication or dosage, whether they were applied for depression, pain, or a combination of both.

Statistical analyses

Statistics were performed for each of the four measurement points independently. Descriptive statistics for demographic and injury characteristics are presented using frequencies and percentages for categorical data. For the comparison between groups the Mann–Whitney-*U* test was computed. Simple linear relationships were quantified using Spearman's (r_s) correlation coefficient. To define factors significantly predicting depressive symptoms, multiple linear regression analyses were performed for each time point separately (backward method).

Results

Incidence and severity of depressive symptoms

In the *overall sample*, at the first measurement point (1 month), 55% did not show depressive symptoms, 38% were within the range of mild, 6% showed moderate and 2% severe depressive symptoms (see Fig. 1a; Table 1). After 3 and 6 months, about 72% were free of symptoms, 24% showed mild, 4% moderate and 1% severe depressive symptoms. At the final examination 1 year after injury, the values were again similar to the first measurement while no patient revealed severe depressive symptoms. Over the whole observation period, the mean 65% of patients revealed no depressive symptoms and about 30% mild depressive symptoms. About 45% of patients were treated with antidepressants at any given time of the study. Patients were accordingly grouped into *no antidepressants* (never used antidepressants during the assessment period) and *intake antidepressants* (used antidepressants at any time point). There was no difference for the variable gender on the BDI scores.

The mean scores of the BDI in the *overall sample* remained stable on a low level. The BDI scores showed the highest values within the first month and at 12 months post injury with a decrease at 3 and 6 months (Fig. 1c). The BDI scores of the overall sample were significantly different between the four measurement times (Friedmann Test, $p = 0.033$). The BDI scores were similarly distributed in the *no antidepressants* although without statistical differences between measurement times. The group *intake antidepressants* scored slightly higher at all time points. For the first three measurement times, the BDI scores were significantly different (Mann–Whitney-*U* test, 1 and 3 months $p < 0.001$, and 3 and 6 months $p = 0.008$).

In the overall sample there was no significant difference for the BDI scores at 3 and 6 months for the patients remaining in the rehabilitation setting compared to outpatients. Accordingly, there was a very low correlation between duration of the rehabilitation and BDI scores, also when the effect of the variable use of antidepressants was removed.

The analysis of the individual course of depressive symptoms revealed that SCI subjects with no symptoms remained stable within the first 6 months while patients with mild symptoms showed an improvement over time (Fig. 1b).

BDI scores and clinical variables

The percentage of patients who experienced pain remained comparably high between the assessment points (1 month, 72%; 3 months, 75%; 6 months, 66%; 12 months, 67%). The pain intensity remained stable and the average pain levels were at 4.5 ± 1.8. There was only a very low correlation between BDI scores and pain intensity at 1 and 6 months (Table 2). The SCIM score significantly improved over time (1 month, mean 32 ± 25; 3 months, 49 ± 28; 6 months, 64 ± 26; 12 months, 71 ± 24, $p < 0.001$, Fig. 1c). SCIM scores were not related to BDI scores.

The neurological variable ASIA impairment scale revealed low correlations with BDI scores at the first two time points (Table 2). Type of lesion (e.g. tetraplegia and paraplegia) did not influence the BDI scores.

BDI scores and patient-rated affective factors

Patient-rated affective factors remained stable during the observation period (see Table 2). Between the groups *no antidepressants* and *intake antidepressants,* significant differences were found for general mood at 1 month ($p < 0.05$) and limitation of daily living at 6 months ($p < 0.05$).

Patient-rated affective factors were generally correlated with BDI scores. Primarily, significant negative correlations were found between BDI scores and self rated mood. Subjects who rated themselves in a good mood were those who more likely scored lower on the BDI, while anxiety, limitation in daily activities, and general health revealed significant but lower positive correlations (Table 2).

Regression analyses

The regression analysis was performed using clinical variables (ASIA impairment scale, SCIM scores), pain intensity, and patient-rated affective factors (mood, anxiety, limitation in daily living and, general state of health).

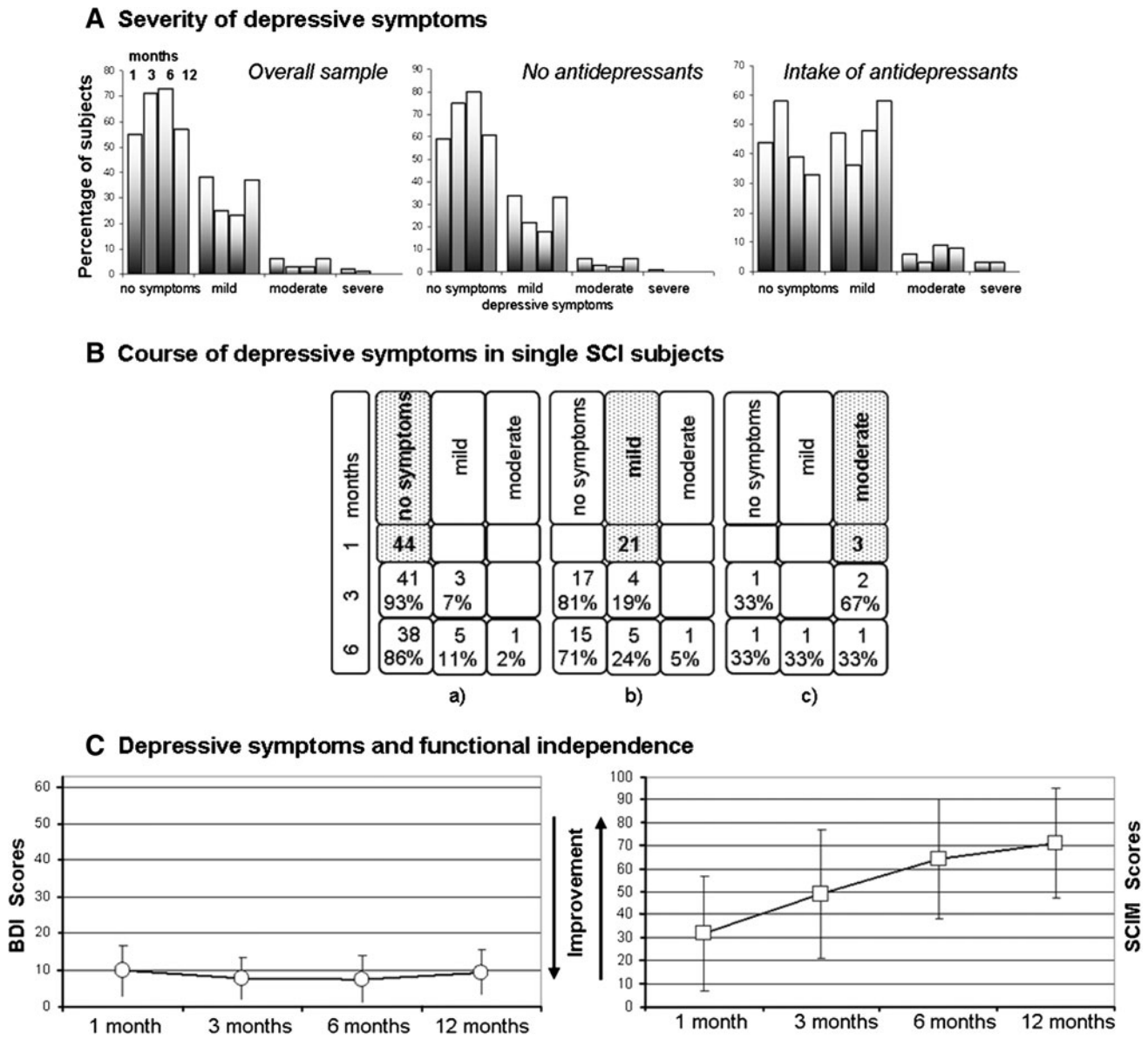

Fig. 1 Time course of depressive symptoms. **a** Percentages of subjects grouped for the severity of depressive symptoms at 1, 3, 6 and 12 months after spinal cord injury. The overall sample is displayed on the *left*, the group without antidepressants in the *middle* and, for the group with intake of antidepressants on the *right* side. The Beck Depression Inventory (BDI) score was used to determine severity of depression: BDI < 10, no; 10–18, mild; 19–29, moderate and >29, severe depressive symptoms. **b** Course of depressive symptoms in single SCI subjects in the patient group without intake of antidepressants: (*a*) Time course of the 44 subjects who did not experience depressive symptoms at 1 month. (*b*) The course of initially mild depressive symptoms in 21 SCI subjects. (*c*) Moderate depressive symptoms were measured at 1 month in three SCI subjects. **c** Time course of depressive symptoms measured with BDI scores and functional independence measured with the SCIM

The linear regression model explained the BDI scores at 1 month after SCI by SCIM score, mood, anxiety, and general state of health with a variance of 65%, while the ASIA impairment scale and limitation in daily living were removed from the model (Table 3). At 3 months, all variables but mood were removed from the model. At 6 months, pain intensity, mood and anxiety were responsible for 63% of the BDI scores. After 12 months, mood and patient-rated limitation in daily living explained 64% of the variance.

Discussion

The frequency of severe depressive symptoms following acute SCI are rather low (less than 5% of moderate to

Table 1 Incidence and severity of depressive symptoms, BDI scores and intake of antidepressant medication following acute SCI

Variables	1 month	3 months	6 months	12 months	Total*
BDI scores					
Overall sample	9.8 ± 6.9	7.6 ± 5.6	7.5 ± 6.3	9.4 ± 6.1	8.5 ± 6.4
Without antidepressant	8.1 ± 6.0	6.1 ± 4.8	6.1 ± 5.2	8.1 ± 5.6	8.1 ± .6
Intake of antidepressant	12.0 ± 7.7	9.3 ± 6.2	8.9 ± 7.2	10.5 ± 6.5	10 ± 7.0
Depression categories					
Overall sample	$N = 123$	$N = 130$	$N = 125$	$N = 81$	
no symptoms	67 (55%)	92 (71%)	91 (73%)	46 (57%)	65%
mild	46 (38%)	33 (25%)	29 (23%)	30 (37%)	30%
moderate	7 (6%)	4 (3%)	4 (3%)	5 (6%)	4%
severe	2 (2%)	1 (1%)	1 (1%)	0	0.9%
Without antidepressant	$N = 68$	$N = 72$	$N = 69$	$N = 41$	
no symptoms	44 (65%)	57 (79%)	56 (81%)	27 (66%)	73%
mild	21 (37%)	13 (23%)	11 (16%)	12 (29%)	23%
moderate	3 (4%)	2 (3%)	2 (3%)	2 (4.9%)	4%
severe	0	0	0	0	
Intake of antidepressant	$N = 55$	$N = 58$	$N = 56$	$N = 40$	
no symptoms	23 (42%)	36 (62%)	36 (64%)	20 (50%)	55%
mild	26 (47%)	19 (33%)	17 (31%)	17 (43%)	38%
moderate	4 (7%)	2 (4%)	2 (4%)	3 (8%)	6%
severe	2 (4%)	1 (2%)	1 (2%)	0	2%
Antidepressants					
No	69	73	70	41	55%
Yes	54 (45%)	57 (44%)	55 (44%)	40 (49%)	45%

BDI Beck depression inventory

Categories of depressive symptoms from the BDI scores, <10, no depression; 10–18, mild depression; 19–29, moderate depression: and >29, severe depression. Presented are means ± standard deviations

* Mean ± standard deviation of all four time points

severe depressive symptoms) irrespective of the acute onset of the disorder and even severe functional impairment (like tetraplegia). The course of depressive symptoms remains stable within 1 year after injury and more than 80% of patients without depressive symptoms within the first month after incident remain unaffected. Interestingly, objective neurological and independence outcomes and even pain intensity did not show a consistent relation to BDI scores. The incidence appears to be lower in acute SCI compared other neurological disorders associated with severe functional impairment.

Appreciation of depressive symptoms

The present study focused on the prevalence of depressive symptoms over 1 year following acute SCI applying the self-reported BDI to quantify the level of depressive symptoms as a proxy of depression [11]. This clear distinction deemed important as a formal diagnosis of depression requires a complex psychiatric work-up that is beyond the screening of depressive symptoms. Furthermore, repeated measures from acute (in-patient) to chronic (out-patient) stages of SCI with a reasonable number of participants and involved centers were considered important to avoid a bias on patient inclusion. In addition, the prospective re-assessments of combined clinical (i.e. neurological and functional) and psychological variables were assumed important to evaluate the relation between the different items [16].

In accordance with previous studies, applying self-reported screening tools psychological distress disorders (like depressive episodes and anxiety disorders) is not an inevitable consequence of SCI [21]. Similar to the present study, recent cross-sectional studies in patients with acute and/or chronic SCI confirmed lower levels in prevalence and severity of depressive symptoms. Saikkonen et al. [31] reported a prevalence of depressive symptoms of nearly one-third of 76 patients (1 year since SCI) and Osteraker et al. [28] revealed mean BDI scores <10 independent of the time since injury in 36 patients from sub-acute (admission) to chronic stages (discharge and 6-month follow-up). There is one comparable prospective longitudinal cohort study in 104 SCI participants that were screened every 6 weeks from acute stages up to 2 years post discharge [22]. They reported increasing BDI scores between 6 and 12 months, while following discharge the scores decreased below the level of acute measurements. Some of the differences might be attributable to the high variability of assessed patients per measurement time due to the applied multiple wave panel study design (range 5–85 subjects) and parallel assessments of clinical outcomes were not performed.

Table 2 Patient-rated factors and correlations between BDI scores and clinical variables and patient-rated factors following acute SCI

Correlations BDI scores and	1 month	3 months	6 months	12 months
Mood	6.4 ± 2.2#	6.8 ± 2.0#	6.7 ± 1.9#	6.9 ± 1.9#
Overall sample	$r_s = -0.53$**	$r_s = -0.59$**	$r_s = -0.56$**	$r_s = -0.52$**
Without antidepressant	$r_s = -0.59$**	$r_s = -0.63$**	$r_s = -0.56$**	$r_s = -0.40$**
Intake of antidepressant	$r_s = -0.39$**	$r_s = -0.52$**	$r_s = -0.50$**	$r_s = -0.60$**
Anxiety	2.9 ± 2.7#	2.5 ± 2.6#	2.4 ± 2.5#	2.3 ± 2.3#
Overall sample	$r_s = 0.38$**	$r_s = 0.27$**	$r_s = 0.38$**	$r_s = 0.49$**
Without antidepressant	$r_s = 0.26$*	n.s.	$r_s = 0.30$*	$r_s = 0.32$*
Intake of antidepressant	$r_s = 0.50$**	$r_s = 0.36$*	$r_s = 0.36$**	$r_s = 0.64$**
Limitation in daily life	7.6 ± 2.4#	6.6 ± 2.4#	6.3 ± 2.8#	6.0 ± 2.8#
Overall sample	$r_s = 0.25$**	$r_s = 0.34$*	$r_s = 0.29$**	$r_s = 0.34$**
Without antidepressant	$r_s = 0.35$**	$r_s = 0.40$**	$r_s = 0.29$*	$r_s = 0.47$**
Intake of antidepressant	n.s.	$r_s = 0.31$*	n.s.	n.s.
State of health				
Overall sample	$r_s = -0.38$**	$r_s = -0.27$**	$r_s = -0.37$**	$r_s = -0.40$**
Without antidepressant	$r_s = -0.33$**	$r_s = -0.28$*	$r_s = -0.46$**	$r_s = -0.36$*
Intake of antidepressant	$r_s = -0.55$**	$r_s = -0.30$*	n.s.	$r_s = -0.44$**
SCIM				
Overall sample	n.s.	n.s.	n.s.	n.s.
Without antidepressant	n.s.	n.s.	n.s.	n.s.
Intake of antidepressant	n.s.	n.s.	n.s.	n.s.
Pain intensity				
Overall sample	$r_s = 0.25$*	n.s.	$r_s = 0.27$*	n.s.
Without antidepressant	n.s.	n.s.	n.s.	n.s.
Intake of antidepressant	n.s.	n.s.	$r_s = 0.40$*	n.s.
AIS				
Overall sample	$r_s = -0.28$**	$r_s = -0.29$**	n.s.	n.s.
Without antidepressant	$r_s = -0.26$*	n.s.	n.s.	n.s.
Intake of antidepressant	$r_s = -0.34$*	n.s.	n.s.	n.s.

BDI Beck Depression Inventory, *AIS* American Spinal Injury Association Impairment Scale, *SCIM* Spinal Cord Independence Measure, *n.s.* not significant

Rated on a NRS for the overall sample

* Correlation is significant at the 0.05 level, ** Correlation is significant at the 0.01 level

The overall incidence of moderate to severe depressive symptoms is rather low in SCI (<5%) and even appears not to be higher than in the adult population of the European Union where an annual prevalence of 3.1–10.1% has been revealed by a meta-analysis [39].

Pain intensity and depressive symptoms

Both the observed prevalence of pain (between 67 and 72%) and average pain rating (mean intensity of 4.5 ± 1.8) [38] is in accordance to previous SCI studies [32]. Interestingly, this investigation revealed no clear relationship between pain intensity and BDI scores compared to earlier reports on pain and mood [9, 38]. This discrepancy might be in some part due to the relatively early observation time window [16]. Patients with acute SCI undergoing first rehabilitation might be rather focused towards their clinical and functional condition, while psychological and social factors might become more imperative when experiencing the manifold challenges in the domestic environment [26].

Neurological–functional impairment and depressive symptoms

Neurological deficit, functional impairment and clinical condition did not show an obvious effect onto mental wellbeing [20]. In fact, the ASIA impairment scale (neurological outcome) was related with BDI scores only within the first 3 months. This corresponds to previous findings where no obvious correlation between depressive symptoms and the level and completeness of the lesion could be disclosed [31]. Accordingly, functional independence (SCIM

Table 3 Regression models explaining BDI scores for the *overall sample*

	Time	Predictors	*B*	SE	*P* value	R^2
BDI scores overall sample	1 month	General state of health	−2.54	0.79	0.00	0.65
		Mood	−0.80	0.30	0.02	
		SCIM score	−0.05	0.03	0.09	
		Anxiety	0.80	0.28	0.05	
	3 months	Mood	−1.30	0.26	0.000	0.60
	6 months	Pain intensity	1.13	0.38	0.004	0.63
		Mood	−1.23	0.38	0.002	
		Anxiety	0.79	0.27	0.005	
	12 months	Mood	−0.99	0.51	0.002	0.64
		Limitation in daily living	0.76	0.33	0.027	

B Regression coefficient, *SE* Standard error, R^2 explained variance, *ASIA* impairment scale, *BDI* Beck Depression Inventory

scores) showed no association with BDI scores [31, 37]. These findings are supported by a study in 11 monozygotic twins where one co-twin sustained a SCI. SCI and non-SCI co-twins showed no significant aberrance in various self-reports [36].

Antidepressant medication and depressive symptoms

This study is the first to monitor the intake of antidepressants (AD) and to follow the long-term course of SCI subjects with or without AD medication. It is remarkable that almost half of the patients were treated with antidepressants. The groups with and without antidepressant medication showed a similar distribution regarding the overall grading and time course of depressive symptoms. Interestingly the post hoc analysis revealed indeed higher BDI scores in the treated group while the patient-rated factors like mood, anxiety and limitation in daily life showed no difference between the groups. It is important to emphasize that neither the indication for antidepressant treatment (mood disturbance or adjunct pain medication) nor dosing of the antidepressant medication was influenced by the study.

Comparison to neurological disorders

To estimate the occurrence of depressive symptoms in comparison to other neurological disorders both mean BDI scores and the percentage in levels of depressive symptoms can be used. In addition, in pre-selected cohorts the severity of depressive symptoms can be specifically disclosed in affected patients.

In stroke patients, the prevalence of depressive symptoms ranged from 18 to 61% [18, 24]. In a cross-sectional cohort study of 181 juvenile stroke patients (18–45 years of age, mean 4.9 years post stroke) about 60% showed depressive symptoms (33.7% revealed even a severe depression) by means of the Hamilton rating scale for depression [23]. In a cohort of 128 first-ever-stroke patients a prevalence of depressive symptoms of 39% was reported (BDI $\geq$10 at some point during the first 12 months) [18]. In 23 survivors with severe chronic impairment following hemi-craniotomy due to stroke a prevalence of 56.5% was observed. Depression appeared to be less influenced by age of the patient and time after incidence [12]. While mean BDI scores in unselected cohorts of stroke patients were comparable to SCI (Fig. 2) the incidence of moderate to severe depressive symptoms in affected patients appear to be increased [14, 15]. Two investigations in depressed stroke patients revealed mean BDIs of 17–18 (in 123 subjects) [25] respectively a mean BDI of about 20 in 74 patients [30]. These values are close to levels observed in non-impaired patients suffering from endogenic major depression (Fig. 2).

In unselected cohorts of MS patients BDI scores of about 12 have been reported [2, 5], while in MS patients treated for depressive symptoms the scores exceeded 16 points. ALS patients scored mean BDI-II values of 15 [34], although the high incidence of depressive symptoms in motor neuron diseases (MND) is controversially discussed by Tedman et al. [35].

Interestingly, in patients with less obvious neurological impairment following acute trauma of the cervical spine and brain, e.g. whiplash injuries, higher incidences of depressive symptoms have been reported. In northern Sweden 148 patients were grouped according to their Neck Disability Index (NDI) 5 years post whiplash injury [27]. The sample with moderate to severe disability showed a mean BDI score of 18 and 25.7% of the overall sample showed mild to severe depressive symptoms.

Obviously the extent and occurrence of depressive symptoms depends on multiple factors while clinical impairment measures are not able to explain the disturbances in mood. However, the comparison of SCI patients with other neurological disorders indicates a higher capacity in SCI patients to respond to the severe disorder. It might be hypothesized that SCI patients without immediate affection of brain function can rely on a high capacity to cope the problems occurring after such a life event (see Fig. 2) [7, 26].

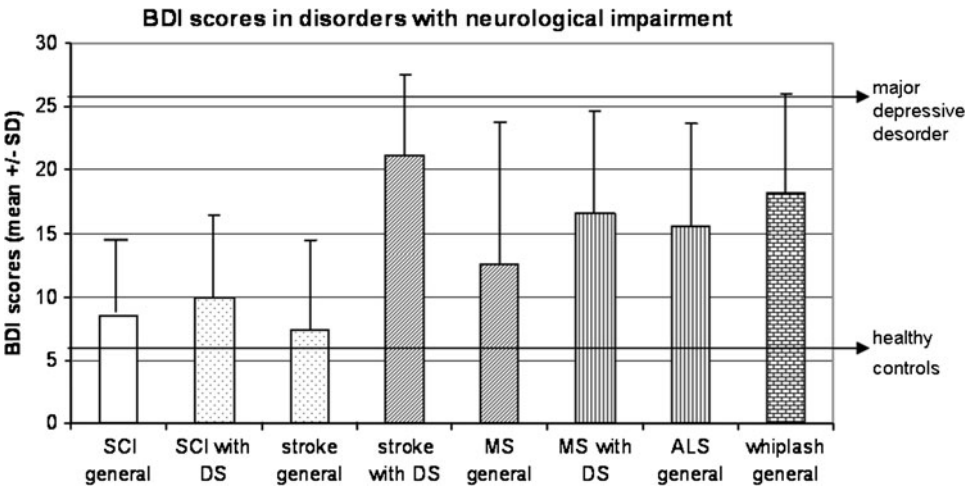

Fig. 2 BDI scores in neurological disorders with sever functional impairment. BDI scores (mean and SD) of unselected (general) and pre-selected cohorts (treated for depressive symptoms) in SCI, MS and stroke patients are presented. For the appreciation of depressive symptoms values of healthy controls and of patients with a major depressive disorder (MDD) are displayed. Healthy controls: BDI 6.57 (SD 5.64); Major depressive disorder: BDI 26.68 (SD 11.12) [4, 39]

Conclusion

The prevalence of depressive symptoms following acute SCI is rather low and not related to neurological deficit, functional impairment and pain. In comparison to other neurological disorders with similar profound functional impairment but also direct involvement of brain function SCI patients seem to respond rather successfully to this serious life event.

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Conflict of interest None.

References

1. Consortium for Spinal Cord Medicine (1998) Clinical practice guidelines: neurogenic bowel management in adults with spinal cord injury. J Spinal Cord Med 21:248–293
2. Alajbegovic A, Loga N, Tiro N, Alajbegovic S, Cindro V, Hozo I (2009) Cognitive and depressive disorders in multiple sclerosis. Acta Clin Croat 48:3–8
3. ASIA (2003) International Standards for Neurological Classification of Spinal Cord Injury Chicago: American Spinal Injury Association
4. Ayuso-Mateos JL (2001) Depressive disorders in Europe: prevalence figures from the ODIN study. Br J Psychiatr 179:308–316
5. Benedict RH, Fishman I, McClellan MM, Bakshi R, Weinstock-Guttman B (2003) Validity of the Beck Depression Inventory-Fast Screen in multiple sclerosis. Mult Scler 9:393–396
6. Binks TM, Radnitz CL, Moran AI, Vinciguerra V (1997) Relationship between level of spinal cord injury and posttraumatic stress disorder symptoms. Ann N Y Acad Sci 821:430–432
7. Boekamp JR, Overholser JC, Schubert DS (1996) Depression following a spinal cord injury. Int J Psychiatry Med 26:329–349
8. Bombardier CH, Richards JS, Krause JS, Tulsky D, Tate DG (2004) Symptoms of major depression in people with spinal cord injury: implications for screening. Arch Phys Med Rehabil 85:1749–1756
9. Cairns DM, Adkins RH, Scott MD (1996) Pain and depression in acute traumatic spinal cord injury: origins of chronic problematic pain? Arch Phys Med Rehabil 77:329–335
10. Craig A, Tran Y, Middleton J (2009) Psychological morbidity and spinal cord injury: a systematic review. Spinal Cord 47:108–114
11. Elliott TR, Frank RG (1996) Depression following spinal cord injury. Arch Phys Med Rehabil 77:816–823
12. Erban P, Woertgen C, Luerding R, Bogdahn U, Schlachetzki F, Horn M (2006) Long-term outcome after hemicraniectomy for space occupying right hemispheric MCA infarction. Clin Neurol Neurosurg 108:384–387
13. Frank RG, Kashani JH, Wonderlich SA, Lising A, Visot LR (1985) Depression and adrenal function in spinal cord injury. Am J Psychiatry 142:252–253
14. Hackett ML, Yapa C, Parag V, Anderson CS (2005) Frequency of depression after stroke: a systematic review of observational studies. Stroke 36:1330–1340
15. Healey AK, Kneebone II, Carroll M, Anderson SJ (2008) A preliminary investigation of the reliability and validity of the Brief Assessment Schedule Depression Cards and the Beck Depression Inventory-Fast Screen to screen for depression in older stroke survivors. Int J Geriatr Psychiatry 23:531–536
16. Hoffman JM, Bombardier CH, Graves DE, Kalpakjian CZ, Krause JS (2011) A longitudinal study of depression from 1 to 5 years after spinal cord injury. Arch Phys Med Rehabil 92:3411–3418

17. Hohmann GW (1975) Psychological aspects of treatment and rehabilitation of the spinal cord injured person. Clin Orthop Relat Res 112:81–88
18. House A, Dennis M, Mogridge L, Warlow C, Hawton K, Jones L (1991) Mood disorders in the year after first stroke. Br J Psychiatry 158:83–92
19. Jensen MP, Hoffman AJ, Cardenas DD (2005) Chronic pain in individuals with spinal cord injury: a survey and longitudinal study. Spinal Cord 43:704–712
20. Kemp BJ, Kahan JS, Krause JS, Adkins RH, Nava G (2004) Treatment of major depression in individuals with spinal cord injury. J Spinal Cord Med 27:22–28
21. Kennedy P, Rogers B (2000) Reported quality of life of people with spinal cord injuries: a longitudinal analysis of the first 6 months post-discharge. Spinal Cord 38:498–503
22. Kennedy P, Rogers BA (2000) Anxiety and depression after spinal cord injury: a longitudinal analysis. Arch Phys Med Rehabil 81:932–937
23. Klose L (2011) Psychosoziale Aspekte juveniler Schlaganfallpatienten—Depression und ge-sundheitsbezogene Lebensqualität nach Hirninfarkt. In: Klinik für Psychiatrie und Psychotherapie. Universität Münster Münster
24. Kotila M, Numminen H, Waltimo O, Kaste M (1998) Depression after stroke: results of the FINNSTROKE study. Stroke 29:368–372
25. Lincoln NB, Flannaghan T (2003) Cognitive behavioral psychotherapy for depression following stroke: a randomized controlled trial. Stroke 34:111–115
26. Lude P, Kennedy P, Evans M, Lude Y, Beedie A (2005) Post traumatic distress symptoms following spinal cord injury: a comparative review of European samples. Spinal Cord 43:102–108
27. Merrick D, Stalnacke BM (2010) Five years post whiplash injury: Symptoms and psychological factors in recovered versus non-recovered. BMC Res Notes 3:190
28. Osteraker AL, Levi R (2005) Indicators of psychological distress in postacute spinal cord injured individuals. Spinal Cord 43:223–229
29. Philip C, Kendall SDH, Aaron T. Beck, Constance L. Hammen and Rick E. Ingram (1987) Issues and recommendations regarding use of the Beck Depression Inventory In: Cognitivetherapy and researchpp 289–29. doi:210.1007/BF01186280
30. Rampello L, Chiechio S, Nicoletti G, Alvano A, Vecchio I, Raffaele R, Malaguarnera M (2004) Prediction of the response to citalopram and reboxetine in post-stroke depressed patients. Psychopharmacology (Berl) 173:73–78
31. Saikkonen J, Karppi P, Huusko TM, Dahlberg A, Makinen J, Uutela T (2004) Life situation of spinal cord-injured persons in Central Finland. Spinal Cord 42:459–465
32. Siddall PJ, McClelland JM, Rutkowski SB, Cousins MJ (2003) A longitudinal study of the prevalence and characteristics of pain in the first 5 years following spinal cord injury. Pain 103:249–257
33. Siller J (1969) Psychological situation of the disabled with spinal cord injuries. Rehabil Lit 30:290–296
34. Taylor L, Wicks P, Leigh PN, Goldstein LH (2010) Prevalence of depression in amyotrophic lateral sclerosis and other motor disorders. Eur J Neurol 17:1047–1053
35. Tedman BM, Young CA, Williams IR (1997) Assessment of depression in patients with motor neuron disease and other neurologically disabling illness. J Neurol Sci 152 (Suppl 1):S75–79
36. Tirch D, Radnitz CL, Bauman WA (1999) Depression and spinal cord injury: a monozygotic twin study. J Spinal Cord Med 22:284–286
37. van Hedel HJ, Dokladal P, Hotz-Boendermaker S (2011) Mismatch between investigator-determined and patient-reported independence after spinal cord injury: consequences for rehabilitation and trials. Neurorehabil Neural Repair. Jun 2 (Epub ahead of print)
38. Widerstrom-Noga EG, Turk DC (2003) Types and effectiveness of treatments used by people with chronic pain associated with spinal cord injuries: influence of pain and psychosocial characteristics. Spinal Cord 41:600–609
39. Wittchen HU, Jacobi F (2005) Size and burden of mental disorders in Europe–a critical review and appraisal of 27 studies. Eur Neuropsychopharmacol 15:357–376